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[TITLE OF THE INVENTION]

VIDEO PROJECTION APPARATUS

[SCOPE OF CLAIMS]

[Claim 1] A video projection apparatus characterized by: placing liquid crystal elements and reflectors in a color separating and synthesizing optical system which separates incident light into color component lights by way of a dichroic film and synthesizes the color component lights by way of the dichroic film at portions from which the separated color component lights are emitted, the liquid crystal elements and reflectors being driven in accordance with image signals; placing, at the side of the color separating and synthesizing optical system where the incident light is made incident to, a polarization beam splitter for supplying a predetermined polarization light as the incident light by reflecting the predetermined polarization light illuminated by a illumination means and a projection lens for projecting the color lights which transmit the polarization beam splitter after being synthesized by the color separating and synthesizing optical system, wherein the color separating and synthesizing optical system consists of a plurality of prisms; the incident light enters from a first plane of a first prism; a predetermined portion of the color component lights is reflected by a second plane of the first prism on which the dichroic film is formed so that the rest of the color component lights being transmitted therethrough; and the predetermined portion of the color component lights enters a liquid crystal display element which is provided at a third plane of the first prism after being reflected by the first plane.

[DETAILED DESCRIPTION OF THE INVENTION]

[APPLICABLE INDUSTRIAL FIELD]

The present invention relates to a projection apparatus to be used for projecting a video image on a screen and, particularly, to an apparatus which uses a two-dimensional liquid display

device for space modulation of light beams.

[PRIOR ART]

Recently, a projection type television image receptor is rapidly prevailing to be seen not only in public facilities but also in homes. This type of apparatus displays an image of original colors by projecting color component images which are produced on three high intensity cathode ray tubes respectively corresponding to color component lights of red (R), green (G) and blue (B) on a screen and then synthesizing the projected images thereon. Fig. 2 shows a schematic outline of the video projection apparatus. Reference numerals 1, 2 and 3 denote cathode ray tubes respectively corresponding to R, G and B, which are driven by R, G and B driving circuits 4, 5 and 6 to which image signals R, G and B are inputted respectively. Reference numerals 7, 8 and 9 denote projection lenses which are so placed in front of the cathode ray tubes 7, 8 and 9 as to focus on a screen 10. In addition, each of the projection lenses in Fig. 2 is represented by a single lens; however, in practice, a projection lens normally consists of a plurality of lenses for the purpose of correcting aberrations.

As is predicted from Fig. 2, a major drawback of the projection apparatus is that the size becomes inevitably large and that the price tends to become expensive. Further, another drawback of requiring cumbersome maintenances such as geometrical distortion corrections of the cathode ray tubes and convergence adjustments of optical axes of the projection lenses for changing distances between the projection lenses and the screen has been detected with the projection apparatus.

[PROBLEMS TO BE SOLVED BY THE INVENTION]

An object of the present invention is to provide an apparatus which is capable of eliminating the above drawbacks and, particularly, small, reduced in the maintenance works and excellent in color reproduction.

In order to achieve the object, a color separation optical system which is usually used for tricolor separation in a television camera and has prisms wherein light enters from a first plane to be

reflected by a dichroic film which is provided on a second plane, followed by being totally reflected by the first plane to go toward a third plane is used in reverse; two-dimensional liquid display elements which are driven by image signals and reflectors are provided sequentially at outgoing planes of the color separation optical system; light path dividing means for changing incident light to be in a predetermined polarized state and separating a light path is provided at a plane of incidence of the color separation optical system; a illumination means is provided at one of the light paths obtained by the light path dividing means; and a projection lens is provided at the other one of the light paths.

[EMBODIMENTS]

One embodiment of the present invention is described below in accordance with Fig. 1. Reference numeral 11 denotes a tricolor color separation optical system which is provided with a first prism 11A, a second prism 11B and a third prism 11C, wherein reference numeral 11a corresponds to a so-called plane of incidence and reference numerals 11b, 11c, and 11d correspond respectively to outgoing planes of color component lights. A dichroic interference thin film which reflects blue and transmits colors having longer wavelengths than blue is deposited on a second plane 11e of the first prism A. A gap is formed between the first prism 11A and the second prism 11B, while a dichroic interference thin film which reflects red and transmits green is deposited on a plane 11f between the second prism 11B and the third prism 11C. Thus, if it is assumed that white light is made incident to the incidence plane 11a, blue light is reflected at the plane 11e and then subjected to an inner total reflection at the plane 11a to be directed toward the outgoing 11b; red light of the light which has passed through the plane 11e is reflected by the plane 11f to be subjected to an inner total reflection at a plane contacting the gap to be directed toward the outgoing plane 11c; and green light which has passed through the plane 11f is directed toward the outgoing plane 11d.

Reference numerals 12, 13 and 14 are two-dimensional liquid crystal elements which display images of the blue component, the red component and the green component. Since

configurations of the elements are known, descriptions thereof are omitted. The liquid crystal display elements 12, 13 and 14 are brought into contact with the outgoing planes 11b, 11c and 11d of the color separation optical system. Reference numerals 15, 16 and 17 are dielectric reflection mirrors which are provided at the back faces of the liquid crystal display elements.

Reference numerals 18, 19 and 20 are driving circuits for the liquid crystal display elements, to which image signals of B, R and G which are obtained by decoding NTSC signals are inputted, for example, so that the liquid crystal display elements 12, 13 and 14 are driven in accordance with the signals.

Reference numeral 21 denotes a polarizing beam splitter (hereafter referred to as "polarizing BS") which is disposed on a set optical axis O of the color separation optical system 11. Reference numeral 22 denotes a collimation lens which is disposed on an optical axis branched by the polarization BS 21, while a white light source 23 such as a halogen lamp is disposed on an approximate focal point of the collimation lens. Reference numeral 24 is a projection lens which is disposed with its optical axis being overlapped with an optical axis which has passed the polarization BS 21. Reference numeral 25 denotes a screen, and the screen 25 and liquid crystal display elements 12, 13 and 14 are so adjusted to be conjugate with respect to the projection lens 24.

In the above-described configuration, a light beam which is emitted from the white light source 23 enters the collimation lens 22 to provide parallel light beams which is directed toward a light division plane of the polarization BS 21, and then a component S thereof is reflected to provide straight polarization light. As described above, the straight polarization light enters the incidence plane 11a of the color separation prism 11 to be separated into color component lights. The color component lights enter the liquid crystal display elements 12, 13 and 14 to be subjected to a space modulation according to the image signals, and then reflected by the reflection mirrors 15, 16 and 17 to pass through the liquid crystal display elements 12, 13 and 14 again from a reverse direction. Here, since each of the liquid crystal display elements has birefringent property, the light beams

reciprocate the display elements and are then emitted therefrom after straight polarization planes being rotated in proportion to the image signals, and then the straight polarization light of the color components are synthesized while passing the light path backward to be emitted from the incident plane 11a of the color separation optical system 11. Then, the components whose polarization planes have been rotated by 90 degrees with respect to the incident light pass through the polarization BS 21 to be projected on the screen 25 by way of the projection lens 24.

[EFFECT]

According to the present invention described above, compactness and light weight are achieved to a remarkable extent as compared with a case of disposing cathode ray tubes and projection lens, and, since the color component lights are projected after being synthesized in the present configuration, no error occurs in the conversion and merely a change of the focusing of the projection lens is sufficient to deal with a change in the distance to the screen, thereby simplifying the operation. Further, since the liquid crystal is used as the image display device, an effect of elimination of geometric distortion such as the cathode ray tube is achieved.

Moreover, since the illumination light path and the projection light path are divided by using the polarization BS as well as the color separation and synthesize are performed by reciprocating the lights in the color separation optical system, the advantage of improving the efficiency in using the light source is achieved. Since the color separation optical system which is usually used for tricolor separation of a television camera and has a prism in which light moves in such a manner that the light enters from a first plane to be reflected by a dichroic film which is provided on a second plane and then totally reflected by the first plane to be directed toward a third plane is used, an angle made by a normal line of the dichroic film face and a main light beam of the incident light is apparently smaller than 45 degrees, thereby regulating changes in wavelength characteristics of transmittivity and reflection to be minor even when the angle of incidence of the light on the dichroic film is changed.

[BRIEF DESCRIPTION OF THE DRAWINGS]

Fig. 1 is an optical sectional view showing the embodiment of the present invention; Fig. 2 is a plan view showing an example of the prior art.

In the drawings, 11 denotes a color separation optical system; 12, 13 and 14 denote liquid crystal display elements; 15, 16 and 17 denote reflection mirrors; 21 denotes a polarization BS; 23 denotes a white light light source; and 24 denotes a projection lens.

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(56)参考文献　特開昭55－74283（ＪＰ，Ａ）

(54)【発明の名称】ビデオ・プロジェクション装置

(57)【特許請求の範囲】

【請求項１】入射光をダイクロイック膜により各色成分光に分解すると共に前記ダイクロイック膜により各色成分光を合成する色分解・合成光学系における前記分解された各色成分光が出射する部分に映像信号に応じて駆動される液晶表示素子と反射体を配し、前記色分解・合成光学系の前記入射光が入射する側に、照明手段からの所定の偏光光を反射することにより前記入射光として前記所定の偏光光を供給する偏光ビームスプリッターと前記色分解・合成光学系により合成されて偏光ビームスプリッターを透過した前記各色光を投影する投影レンズとを配し、前記色分解・合成光学系は複数ののプリズムより成り、前記入射光は第１のプリズムの第１面から入射し、前記ダイクロイック膜が形成された前記第１のプリズムの第２面で所定の色成分光が反射されて残りの色成分光が透過せしめられ、前記所定の色成分光が前記第１面で反射された後に前記第１のプリズムの第３面に設けた液晶表示素子に入射することを特徴とするビデオ・プロジェクション装置。

【発明の詳細な説明】

〔産業上の利用分野〕

本発明は、ビデオ画像をスクリーン上に投影するためのプロジェクション装置に関し、殊に光束の空間変調に２次元液晶表示素子を使用した装置に関する。

〔従来の技術〕

最近、プロジェクション型のテレビ受像器が急速に普及してきており、公共施設のみならず家庭でも見られる様になってきている。この種の装置は、赤（R）緑（G）青（B）の各色成分光に対応する３本の高輝度陰極線管に映出された色成分画像を投影レンズでスクリーンに投影してそこで合成し、元の色彩の画像を表示する様にしている。第２図はビデオ・プロジェクション装置の概要を示している。1,2,3は夫々R,G,Bに対応する陰極線管で、R,G,Bの映像信号が各々入力されるR,G,Bのドライブ回路4,5,6により駆動される。7,8,9は投影レンズで、陰極線管7,8,9の前方にスクリーン10にピントを合わせて夫々配置される。尚、本図では投影レンズを単レンズで示したが、実際には諸収差補正のために複数枚のレンズから構成されるのが普通である。

第２図からでも予想される様にプロジェクション装置は装置自体が大型となるのが大きな欠点であり、また高価になり易い。更に投影レンズとスクリーンの距離を変えると、各投影レンズの光軸のコンバージエンス調整あるいは陰極線管像の幾何学的歪みの補正を行うなどメインテナンスの手間を要する欠点があった。

〔発明が解決しようとしている問題点〕

本発明は上記欠点を除去し、特に小型でメインテナンス作業を軽減した色再現性の優れた装置の提供を目的とする。

そしてこの目的を達成するために、通常テレビカメラの３色色分解に使われる様な色分解光学系、つまりプリズムの第１の面から入射し第２の面に設けられたダイクロイック膜で反射した光が前記第１の面で全反射してから第３の面に向かうようなプリズムを有する色分解光学系を逆に使用し、色分解光学系の各出射部相当側に映像信号で駆動される２次元液晶表示素子と反射体とを夫々順置し、前記色分解光学系の入射部相当側に入射光を所定の偏光状態にすると共に光路を分割する光路分割手段を配置し、更に前記光路分割手段で分割された光路の一方に照明手段、他方に投影レンズを配置するものである。

〔実施例〕

以下、第１図に従って本発明の一実施例を説明する。まず11は３色色分解光学系で、第１プリズム11A、第２プリズム11B、第３プリズム11Cを具え、11aがいわゆる入射面、11b,11c,11dが各色成分光の出射面に相当する。第１プリズムAの第２面11eには青を反射しそれより長波長域を透過させるダイクロイツク干渉薄膜が蒸着されている。第１プリズム11Aと第２プリズム11Bの間には空隙が置かれ、又第２プリズム11Bと第３プリズム11Cの間の11f面には赤反射緑透過のダイクロイツク干渉薄膜が蒸着されている。従って、入射面11aに白色光が入射したと仮定すると、面11eで青色光は反射され、面11aで内面全反射して出射11bへ向い、面11eを透過した光の内、面11fで反射した赤色光は空隙に接する面で内面反射して出射面11cへ向い、面11fを透過した緑色光は出射面11dへ向う。

12,13,14は順に青色成分の映像、赤色成分の映像、緑色成分の映像を表示する２次元液晶素子である。素子自体の構成は周知であるから説明を省く。これら液晶表示素子12,13,14は色分解光学系の出射面11b,11c,11dに接着されている。15,16,17は誘電体の反射鏡で液晶表示素子12,13,14の裏面に設けられている。

18,19,20は液晶表示素子の駆動回路で、例えばNTSC信号からカラーデコーダされたB,R,Gの映像信号が夫々入力され、この信号に応じて各液晶表示素子12,13,14を駆動する。

21は偏光ビーム・スプリッター（以下、偏光BSと云う）で色分解光学系11の設定光軸O上に配置する。22はコリメーションレンズで、偏光BS21で分岐された光軸上に配置し、更にコリメーションレンズのほぼ焦点上にハロゲンランプの様な白色光源23を配置する。24は投影レンズで、偏光BS21を経由した光軸にその光軸を一致させて配置する。25はスクリーンで、スクリーン25と各液晶表示素子12,13,14は投影レンズ24に関して共役となる様に調整される。

以上の構成で、白色光源23を発した光束はコリメーションレンズ22へ入射して平行光束となり、偏光BS21の光分割面へ向いＳ成分が反射し、直線偏光々となる。直線偏光々は色分解プリズム11の入射面11aへ入射し、既に説明した通り色成分光に分解されて各液晶表示素子12,13,14へ入射し、そこで映像信号に応じて空間変調され、反射鏡15,16,17で反射して再び液晶表示素子12,13,14を逆方向から通過する。ここで液晶表示素子は複屈折性を有するので、光束は素子内の往復後、直線偏光面が映像信号に比例して回転して出射し、これら各色成分の直線偏光光が光路を逆行する内で合成されて色分解光学系11の入射面11aから射出し、偏光面が入射光に対し90°回転した成分が今度は偏光BS21を通過し、投影レンズ24でスクリーン25へ投影される。

〔効果〕

以上述べた本発明によれば、各々陰極線管と投影レンズを配置する場合に比較して遥かに小型で軽量となる効果があり、また各色成分光は合成された後、投影される構成を採用しているので、コンバージョンのミスが発生することなく、スクリーンまでの距離を変えた場合でも投影レンズのフオーカシングを取り直すだけで済むなど操作が簡便となる。また映像表示器として液晶を使っているので、陰極線管の様な幾何歪がなくなる効果もある。

更に偏光BSを使って照明光路と投光光路を分割し、また光を色分解光学系内を往復させて色の分解、合成を行っているので、光源の光の利用効率が高まる利点がある。また、通常のテレビカメラの３色色分解に使われる様な色分解光学系、つまりプリズムの第１の面から入射し第２の面に設けられたダイクロイック膜で反射した光が前記第１の面で全反射してから第３の面に向かうようなプリズムを有する色分解光学系を用いているので、ダイクロイック膜面の法線と入射光の主光線とのなす角が45度より明らかに小さくなる為ダイクロイック膜への光

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の入射角が変化しても透過、反射の波長特性の変化を小さくする事ができる。

【図面の簡単な説明】

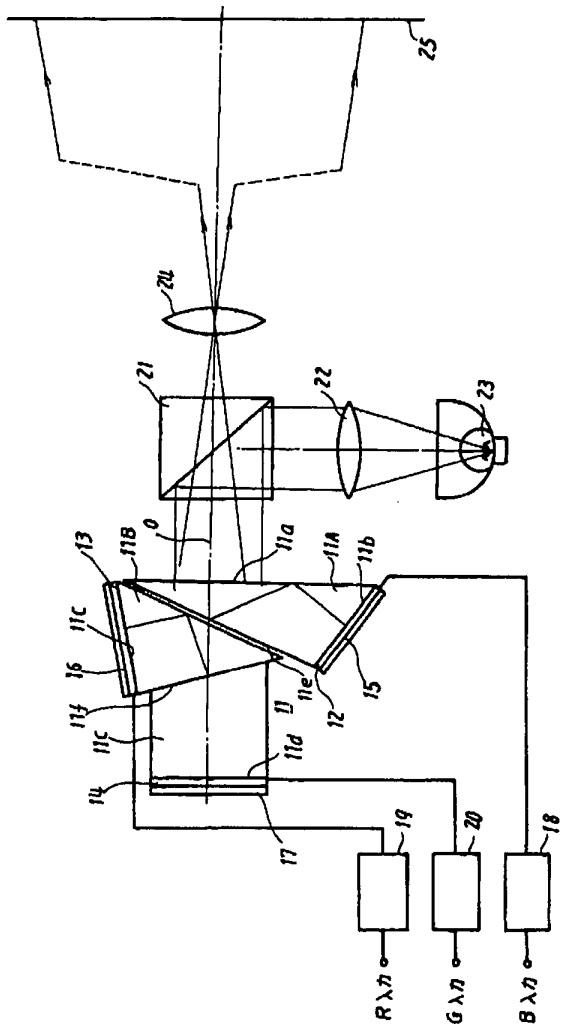
第１図は本発明の実施例を示す光学断面図、第２図は従来例を示す平面図。

6

図中、

11は色分解光学系、12・13・14は液晶表示素子、15・16・17は反射鏡、21は偏光BS、23は白色光源、24は投影レンズである。

【第１図】



【第２図】